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(54) **MODULAR PRINTHEAD**

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(58) **Field of Search** ..... 347/123, 127, 347/128, 152

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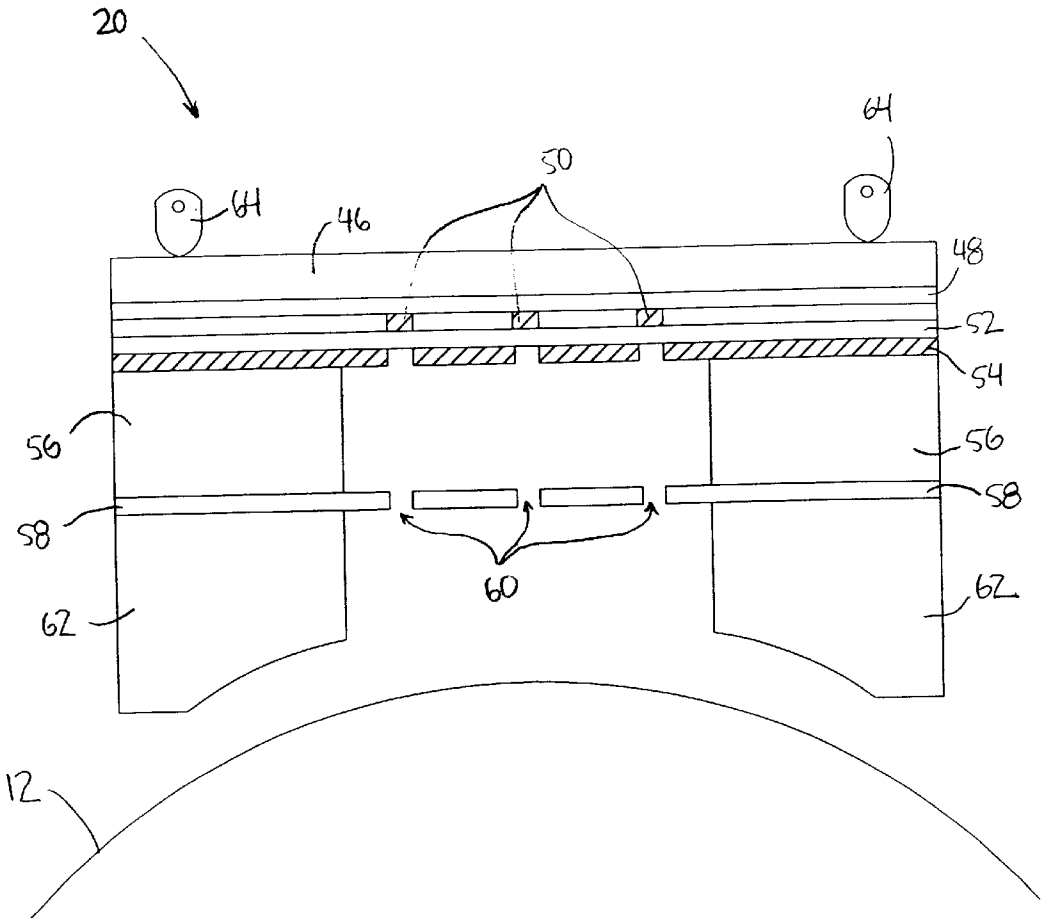
(57) **ABSTRACT**

A modular printhead is disclosed having the ability to separate, leaving a first collection of predetermined layers relatively permanently affixed to a print engine while a second collection of predetermined layers resides in a relatively disposable component thereof. The modular printhead includes a first printhead component having at least a first electrode and a second electrode. There is additionally a second component of the printhead. The second component can have a third electrode. The first printhead component of the printhead demountably presses against the second component, held in place by at least one fastening mechanism.

**15 Claims, 3 Drawing Sheets**



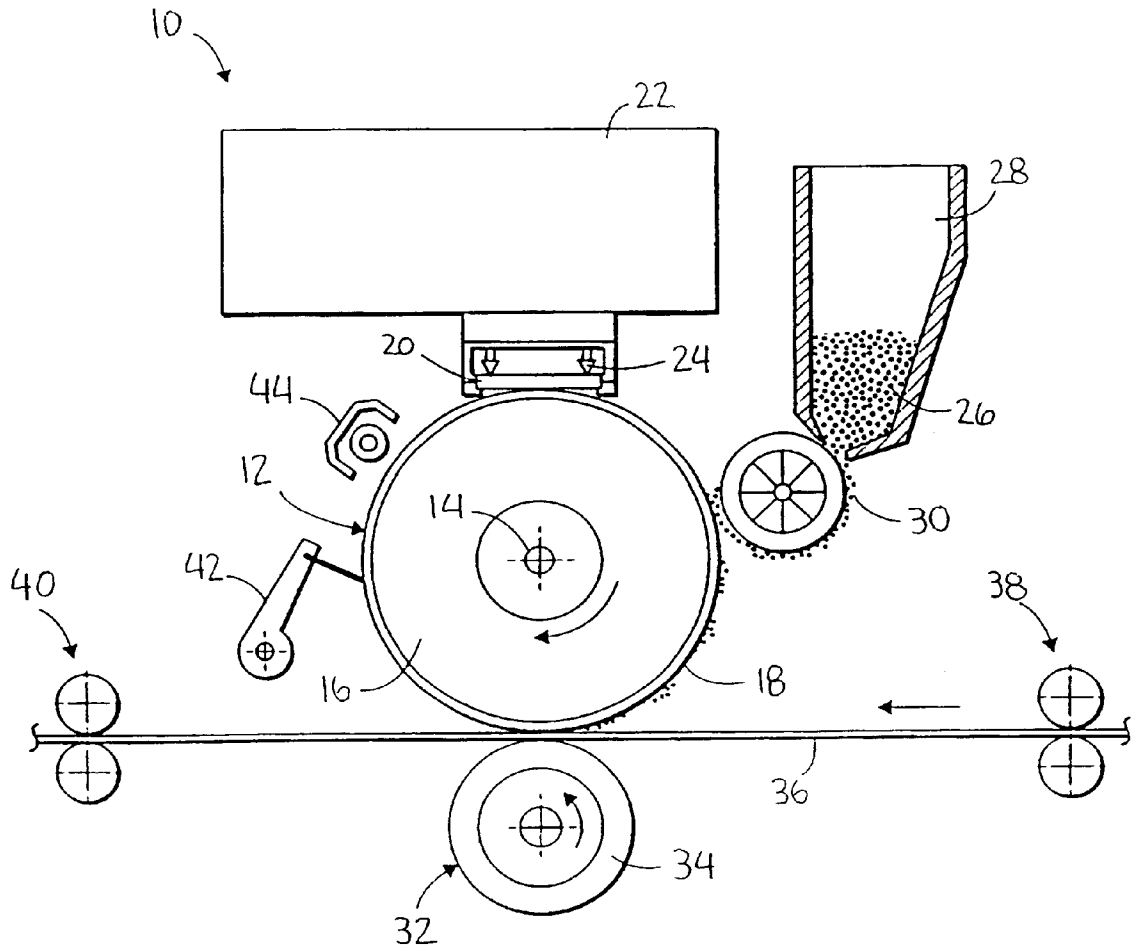



FIG. 1

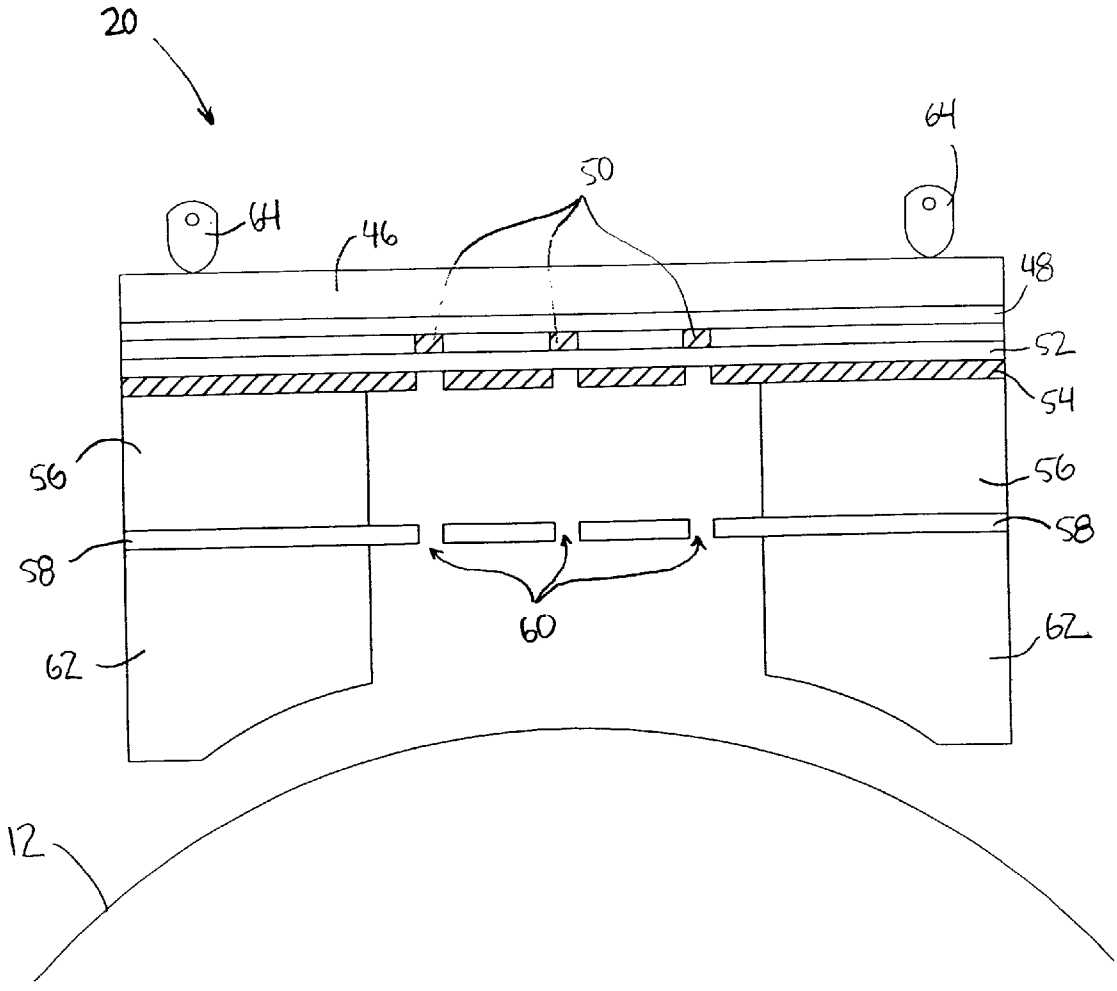



FIG. 2

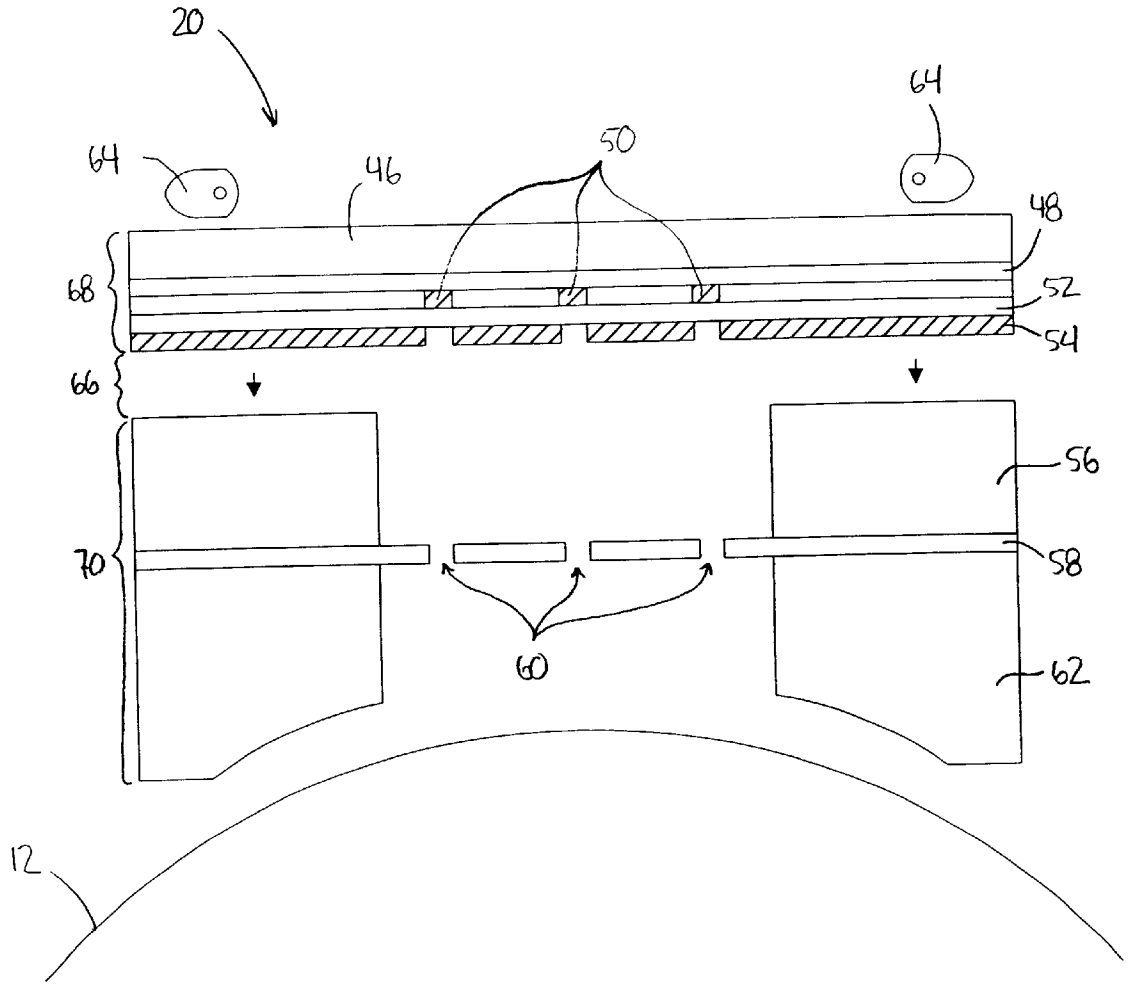



Fig. 3

# MODULAR PRINTHEAD

## FIELD OF THE INVENTION

The invention relates to a printhead suitable for use with image forming systems, and more particularly relates to a modular printhead arrangement.

## BACKGROUND OF THE INVENTION

Different printhead technologies in use today in image forming systems create and reproduce images in different ways. Some of these technologies include a process of charging a dielectric layer on a surface of a drum with an electronic image. A developer then transfers developer material, such as toner particles, to the charged surface. Rollers then press a printing medium, such as a sheet of paper, against the developed toner particles to permanently affix the toner particles to the paper sheet.

An alternative arrangement provides a photoconductive member within the imaging device charged to a substantially uniform potential. The light image of a document projects onto the photoconductive member, dissipating the charge on selected areas of the photoconductive member. The dissipation of charge results in an electrostatic image forming on the photoconductive member, which corresponds to a particular image on a document. A similar process develops a toner particle image and transfers it to a paper sheet.

One specific type of image forming system is an electrostatographic image system. Such image forming systems typically include at least one image forming device, such as a printhead. A known configuration for a printhead is a three layer structure. A first layer is an electrode layer, a second layer is a dielectric layer, and a third layer is another electrode layer. Electrodes within each of the electrode layers cross with electrodes from the other of the electrode layers, forming intersections, physically separated by the dielectric layer. These electrode intersections form charge generation sites.

Current printhead technology has resulted in a combination of layers, in addition to the basic three layers, to form the printhead. Some of the added layers are relatively expensive, causing the cost for the overall printhead to exceed that which is supported by the marketplace.

## SUMMARY OF THE INVENTION

There exists in the art a need for a modular printhead having the ability to separate a first collection of predetermined layers relatively permanently affixed to a print engine from a second collection of predetermined layers residing in a relatively disposable component thereof.

A modular printhead, according to one aspect, includes a first printhead component having at least a first electrode, a second electrode. A second component of the printhead can have a third electrode. The first printhead component of the printhead is separable from the second component and couples thereto in a removable and replaceable manner. A fastening mechanism or mounting element can press the components together, holding them in position.

The first electrode is an RF-line, or drive, electrode or electrode array, the second electrode is a finger electrode or electrode array, and the third electrode is a screen electrode or electrode array, in more common configurations and according to the teachings of the present invention. The first printhead component further includes a dielectric layer, to electrically insulate the first electrode (RF-line electrode) from the second electrode (finger electrode). A number of different materials can form the dielectric layer, including semi-conductor materials.



A spacer layer separates the second electrode and the third electrode in accordance with further aspects of the present invention. Mounting blocks mount the third electrode in place.

## BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned features and advantages, and other features and aspects of the present invention, will become better understood with regard to the following description and accompanying drawings, wherein:

FIG. **1** is a diagrammatic illustration of an image forming system;

FIG. **2** is a diagrammatic illustration of a printhead suitable for use in the image forming system of FIG. **1**, according to the teachings of the present invention; and

FIG. **3** is a diagrammatic illustration of the printhead of FIG. **2**, illustrating the separation of selected components.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention generally relates to a modular printhead mounted within an image forming system. A characteristic of the modular printhead is that there exists at least two components of the printhead structure. A first printhead component contains several layers contributing to the formation of the printhead that share one or more common characteristics. The first printhead component, for example, can contain a layer or layers that are generally less expensive than a second layer or layers found in the second component of the printhead. The second component of the printhead mounts in the print engine and contains components that should not need to be replaced during the life of the image forming system. The first printhead component can include parts that are less costly to replace, and are disposable as necessary. More specifically, when components within the first printhead component of the printhead wear out, a user removes the first printhead component and replaces it with a like component to restore printhead function. This procedure leaves the second component in tact in the print engine of the image forming system. Such an arrangement results in a printhead that is more easily maintained and is relatively less costly to the owner of the image forming system.

Referring now in detail to the figures wherein like parts are designated by like reference numerals throughout, FIGS. **1** through **3** illustrate an example embodiment of a modular printhead according to the teachings of the present invention. Although the present invention will be described with reference to the example embodiments illustrated in the figures, it should be understood that the present invention can be embodied in many alternative forms. In addition, any suitable size, shape, or type of elements or materials can be utilized.

The image forming system illustrated is shown solely for the purpose of providing a general structure in which the present invention can reside. One skilled in the art will understand that other image forming systems, or charge transfer apparatus can be utilized in combination with different embodiments of the present invention, without departing from the spirit and scope of the invention herein. Image forming systems, for example, can include a collection of different technologies, such as electrophotographic, electrostatic, electrostatographic, ionographic, acoustic,

inkjet, and other types of image forming or reproducing systems that are adapted to capture and/or store image data associated with a particular object, such as a document, and reproduce, form, or produce an image.

FIG. **1** illustrates an image forming system **10** that can have a drum **12** that mounts for rotation about an axis **14**. The drum **12** incorporates an electrically conductive core **16** coated with a dielectric layer **18**. An alternative structure, known to those of ordinary skill in the art and therefore not shown herein, provides a wide belt supporting the dielectric layer and rotating around several wheel mechanisms.

The dielectric layer **18** receives a charged image from a printhead **20**. Electrical connectors **24** connect a controller **22**, which drives the printhead **20** as desired. As the drum **12** rotates in the direction of the arrow shown around the axis **14**, charge generation sites within the printhead **20** generate the charged image and transfer the image to the dielectric layer **18** on the outer surface of the drum **12**. The drum **12** continues to rotate as a hopper **28** feeds toner particles **26** through a feeder **30** to the charged portion of the dielectric layer **18**. The toner particles **26** electrostatically adhere to the charged image on the dielectric layer **18**, developing the charged image into a toner image. The rotating drum **12** then carries the toner image towards a nip formed with a pressure roller **32**. The pressure roller **32** has an outer layer **34** positioned in the path of a receptor, such as a paper sheet **36**. The paper sheet **36** enters between a pair of feed rollers **38**. The pressure in the nip is sufficient to cause the toner particles **26** to transfer to the paper sheet **36**, permanently affixing the toner particles **26** thereto. The paper sheet **36** continues through and exits between a pair of output rollers **40**. After passing through the nip between the drum **12** and the pressure roller **32**, a scraper blade assembly **42** removes any toner particles **26** that may remain on the dielectric layer **18**. A discharge head **44** positioned between the scrapper blade assembly **42** and the printhead **20** removes any residual charge remaining on the dielectric layer **18** surface. The process repeats for the next image.

FIG. **2** illustrates a unique printhead **20** configuration according to the teachings of the present invention. The printhead **20** has a series of different layers. There is a backbone **46** at one end, which serves as a base support for the printhead **20**. The backbone **46** can be made of a number of different materials including, e.g., plastics, composites, or other like materials able to structurally support the pressures placed on the printhead **20** during operation. A substrate **48** layer adheres to the backbone **46**. The substrate **48** provides a support structure for the RF-line electrodes **50**. A dielectric layer **52** separates the RF-line, or drive, electrodes **50** from a layer of finger electrodes **54**. The dielectric layer, or dielectric composition, as disclosed herein includes a number of different structures and materials. The dielectric, for example, can be a single layer of a single material, or a plurality of layers of either the same or differing dielectric materials. A plethora of compositions can form the dielectric. Some possible materials include silicon dioxide, aluminum oxide, magnesium oxide, silicon nitride, and boron nitride.

As viewed from a point in space generally orthogonal to the plane containing each of the electrode layers, the RF-line electrodes **50** form intersections with the finger electrodes **54**. However, the electrodes **50** and **54** are physically separated, and electrically insulated from each other, by at least one dielectric layer **52** or composition, as viewed from a cross-sectional perspective of the printhead film containing the electrode and dielectric layers.

The finger electrodes **54** are adjacent a spacer **56**, which maintains a desired distance between the finger electrodes **54** and a screen electrode layer **58**. A set of mounting blocks **62** mount to the screen electrode **58**, completing the modular printhead **20**. The screen electrode **58** has within it a series of screen holes **60** in alignment or registration with the intersections of the RF-line electrodes **50** and the finger electrodes **54**.

The spacer **56** and the screen electrode **58** are not requirements of the modular printhead **20**. In the embodiment illustrated, they do form a substantial portion of the second printhead component **70**. However, the second printhead component **70** can be formed from other layers within the printhead **20** as further discussed below.

FIG. **3** illustrates the printhead **20** according to one aspect of the present invention, split into two separable and connectable components **68** and **70**. The backbone portion **46** of the first printhead component **68** supports the substrate layer **48**. The RF-line electrodes **50** mount on the substrate **48** layer. The dielectric layer **52** electrically insulates RF-line electrodes **50** from the finger electrodes **54**. This first group of layers forms the removable and replaceable first printhead component **68**. Between the removable and replaceable first printhead component **68** and the spacer **56** is a gap **66**. This gap **66** represents the splitting point between each of the printhead components **68** and **70**.

The spacer **56** of the second printhead component **70** supports the screen electrode **58**, which mounts thereto with the mounting blocks **62**. The screen electrode **58** includes screen holes **60** in registration with the intersections of the RF-line electrodes **50** and the finger electrodes **54**. The spacer **56**, the screen electrode **58**, and the mounting blocks **62** form the second printhead component **70**.

The collection of layers that form each of the illustrated components **68** and **70** is not restricted to the embodiment illustrated herein. The printhead **20** can separate at several different locations, depending on the various motivations for utilizing the modular feature, and can contain a different number and type of layers. A significant advantage of the printhead **20** of the invention is the relatively low cost achieved by separating the printhead **20**. The more expensive and longer lasting layers are in the semi-permanent second printhead component **70**, while the less expensive layers are in the removable, replaceable, and disposable first printhead component **68**. A cost efficiency results by placing the less costly layers of the printhead **20** that have shorter life spans or need to be cleaned more often in the removable and replaceable first printhead component **68**. The user must replace only the less costly portion of the printhead **20** in order to achieve an extended printhead life.

An electroforming process, as understood by one of ordinary skill in the art and therefore not further discussed herein, can form the thick film that forms the screen electrode **58** in the illustrated embodiment. The electroforming process is a method of achieving the thickness required for spanning between the overall width of the printhead **20**, while concomitantly achieving the required accuracy to place the screen holes **60** in line with the RF-line electrode **50** and finger electrode **54** intersections. If the electroformed thick film were in the disposable component of the printhead **20**, the cost would be prohibitive for the targeted user. However, the second printhead component **70** is semi-permanently fixed in the printing engine and is not typically discarded with the first printhead component **68**. This allows for the use of more expensive, higher quality, longer lasting elements.

The spacer **56**, as viewed in FIG. **3**, is the next largest contributor to charge output variation. Therefore, control of the thickness of the spacer **56** is a significant factor in the design of printheads. According to aspects of the present invention, the spacer **56** permanently attaches to the engine mounted screen electrode **58**. The spacer **56** can be formed of high precision materials, such as glass, ceramic, and the like. The relative high cost of these materials is justified by semi-permanently mounting the spacer **56**, and hence the second printhead component **70**, in the print engine. This results in a higher quality print output, and therefore a better overall printhead.

The foregoing components **68** and **70** can be assembled in a removable and replaceable manner to form the modular printhead **20** of the present invention. For example, a retaining mechanism, such as retaining cams **64**, can rotate to press the first and second printhead components **68** and **70** together in locking fashion (see FIG. **2**). The retaining cams **64** can rotate in an opposite direction to release the first and second printhead components **68** and **70** (see FIG. **3**). The modular design of the printhead **20** provides for relatively easy maintenance. A user can remove the first printhead component **68** of the printhead **20** from the second printhead component **70** to gain access to screen holes **60** for maintenance and cleaning. This extends the life of the screen electrode **58**, and maintains good print quality. Further, the rigidity of the thick film screen electrode **58** allows for easy cleaning of the screen electrode **58**. This is not possible with thin film screens utilized in other printhead applications, which are instead replaced. Corona bi-products can also be removed from the finger electrodes **54**, which are exposed when the first printhead component **68** and second printhead component **70** of the modular printhead **20** separate.

In addition to the improved access to the screen holes **60** and the finger electrodes **54**, the printhead **20** is relatively less expensive to construct because it has a simpler design. More specifically, in the illustrated printhead **20**, there are no additional layers above the finger electrode **54** layer, which simplifies the manufacturing process. Furthermore, arranging the screen electrode **58** and the spacer **56** within the machine places the more costly elements of the printhead on the more permanent print engine, which is designed to last the life of the image forming system **10**.

Numerous modifications and alternative embodiments of the invention will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the best mode for carrying out the invention. Details of the structure may vary substantially without departing from the spirit of the invention, and exclusive use of all modifications that come within the scope of the appended claims is reserved. It is intended that the invention be limited only to the extent required by the appended claims and the applicable rules of law.

What is claimed is:

**1**. A modular printhead, comprising:

a first printhead component;

a separable screen component, wherein said first printhead component is configured to be removably and replaceably coupled with said screen component to form said modular printhead, said screen component having a spacer mounted with a screen electrode; and

a mounting element for pressing said first printhead component against said screen component so as to hold said first printhead component in place when assembled.

**2**. The modular printhead of claim **1**, wherein said first printhead component comprises a first electrode layer, a dielectric layer, and a second electrode layer.

**3**. The modular printhead of claim **1**, wherein said mounting element comprises at least one retaining cam.

**4**. The modular printhead of claim **1**, wherein at least one of said first printhead component is disposable.

**5**. The modular printhead of claim **1**, wherein said first printhead component further comprises at least one RF-line electrode layer, at least one dielectric layer, and at least one finger electrode layer.

**6**. In an image forming system, a modular printhead, said printhead comprising:

a first printhead component having at least a first electrode layer and a second electrode layer;

a second component having at least a third electrode layer; and means for pressing together said first and second components to form said modular printhead.

**7**. The modular printhead of claim **6**, wherein said first electrode comprises one or more RF-line electrodes.

**8**. The modular printhead of claim **6**, wherein said second electrode comprises one or more finger electrodes.

**9**. The modular printhead of claim **6**, wherein said third electrode comprises one or more screen electrodes.

**10**. The modular printhead of claim **6**, wherein said first printhead component further comprises a dielectric layer electrically insulating said first electrode from said second electrode.

**11**. The modular printhead of claim **6**, wherein said second component further comprises a spacer layer disposed between said second electrode and said third electrode.

**12**. The modular printhead of claim **6**, wherein said second component further comprises one or more mounting elements for retaining said third electrode in place.

**13**. The modular printhead of claim **6**, wherein said means for pressing comprises at least one mounting element.

**14**. The modular printhead of claim **13**, wherein said mounting device comprises at least one retaining cam.

**15**. The modular printhead of claim **6**, wherein said first printhead component is removably and replaceably coupled to said second component during use.

* * * * *